RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: 4th

Wisconsin Department of Transportation
DT1241 2009

Research, Development and Technology Transfer	
Program: (Choose One) ☐ **Policy Research** ☐ **Pooled Fund** **TPF #** ☒ **Wisconsin Highway Research Program** ☐ **Other**	
Project Title:	
Administrative Contact/Phone #: Peg Lafky/(608)266-3663	**WisDOT Project ID(s):** 0092-09-05
WisDOT Technical Contact/Phone #: Robert Arndorfer / (608)246-7940	**Other Project ID:**
Project Investigator/Phone # (agency & contact): James Schneider (jamess@cae.wisc.edu) 608-890-2662	**Approved Starting Date:** 2/5/2009
WisDOT Comments:	**Original End Date:** 2/5/2012
	Current End Date: 2/5/2012
Sponsor: Wisconsin Department of Transportation	**Number of Extensions:**

Schedule Status:

☐ On schedule ☐ Ahead of schedule
☒ On revised schedule ☐ Behind schedule (Please explain below)

Total Project Budget	Expenditures Current Quarter	Total Expenditures	% Funds Expended	% Work Completed
$109,893.00	$4,826.55	$22,534.69	20	14

Project Description:
The overall research objective of this study is to produce a document summarizing simplified design procedures for evaluation of foundation movements for transportation structures within the LRFD framework. Recommendations for the measurement and selection of input parameters for those design procedures will also be provided.

Progress This Quarter: (Includes project committee meetings, work plan status, contract status, significant progress, etc.)
The project consists of five main tasks (1) Literature Review and Database Development; (2) Field Monitoring of Shallow Foundations; (3) Field Monitoring of Deep Foundations; (4) Field Monitoring of Laterally Loaded Piles; and (5) Data Compilation and Analysis. Tasks this quarter have focused on development and calibration of instrumentation that will be applied in stages 2, 3, and 4.

This progress report will focus on two aspects of calibration:
- comparison of calculated and measured rotation
- long term stability of instruments

Wireless accelerometers are being used to measure rotations, an important consideration for assessing movements of bridge abutments. Figure 1 illustrates changes in measured acceleration with time. The large steps indicate induced rotations of:
- 0^o
- 7^o
- 10.5^o
- 20.5^o
- 30^o
- 0^o

The variation in readings with time at a constant rotation is an indication of the accuracy of the measurements, suggesting that these accelerometers are accurate to about +/- 0.5^o. The zero reading was fairly consistent before and after the test.

Similar studies have been performed with additional accelerometers, and Figure 2 illustrates a comparison of response for 5 different devices. Good comparison is achieved using the different devices.

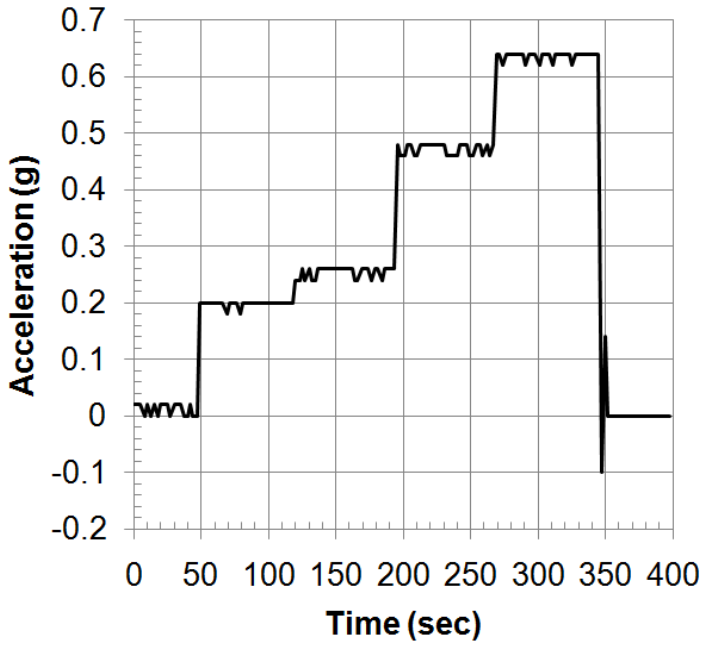


Figure 1. Measured acceleration vs. time

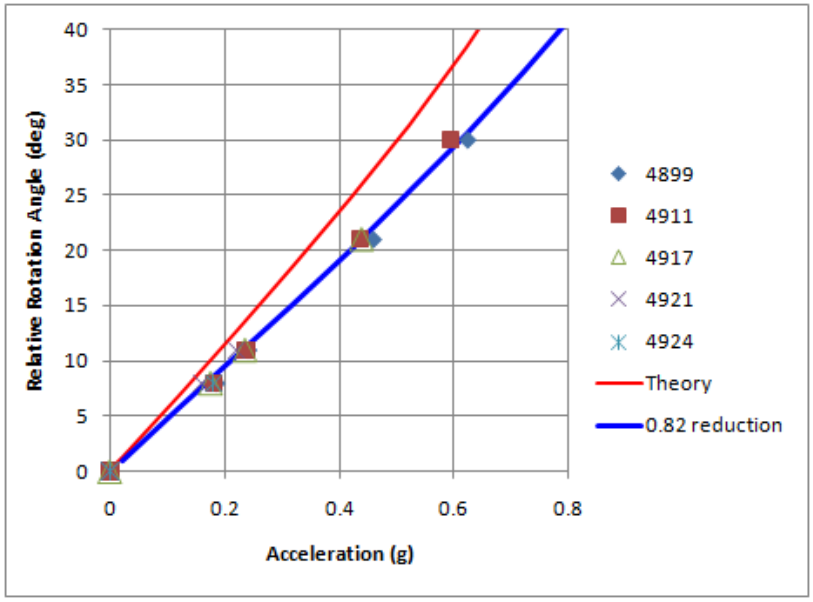


Figure 2. Comparison of calculated and measured rotations

The theoretical rotation angle is compared to the measured rotation angle in Figure 2. The theoretical rotation angle (θ) is:

$$\theta = \sin^{-1}\left(a/g\right)$$

Where a is the measured acceleration and g is the acceleration due to gravity. Measured data plot at about 82% of the theoretical line. This seems to be related to variations in power to the sensors. As the battery drains the power to the sensor reduces. As the power reduces, the output also reduces, leading to an underprediction of rotation. This potential for underprediction of rotation will affect the long term stability and accuracy of the measurements. Additional studies are currently being performed looking at long term stability.

Anticipated Work Next Quarter:
We will continue with calibration of the rotation sensors, as well as start to look at load measurement sensors. The load measurement sensors include:
- Geokon VW rebar strainmeter, “Sister Bar”, #4 rebar
- Geokon LC-2 Datalogger

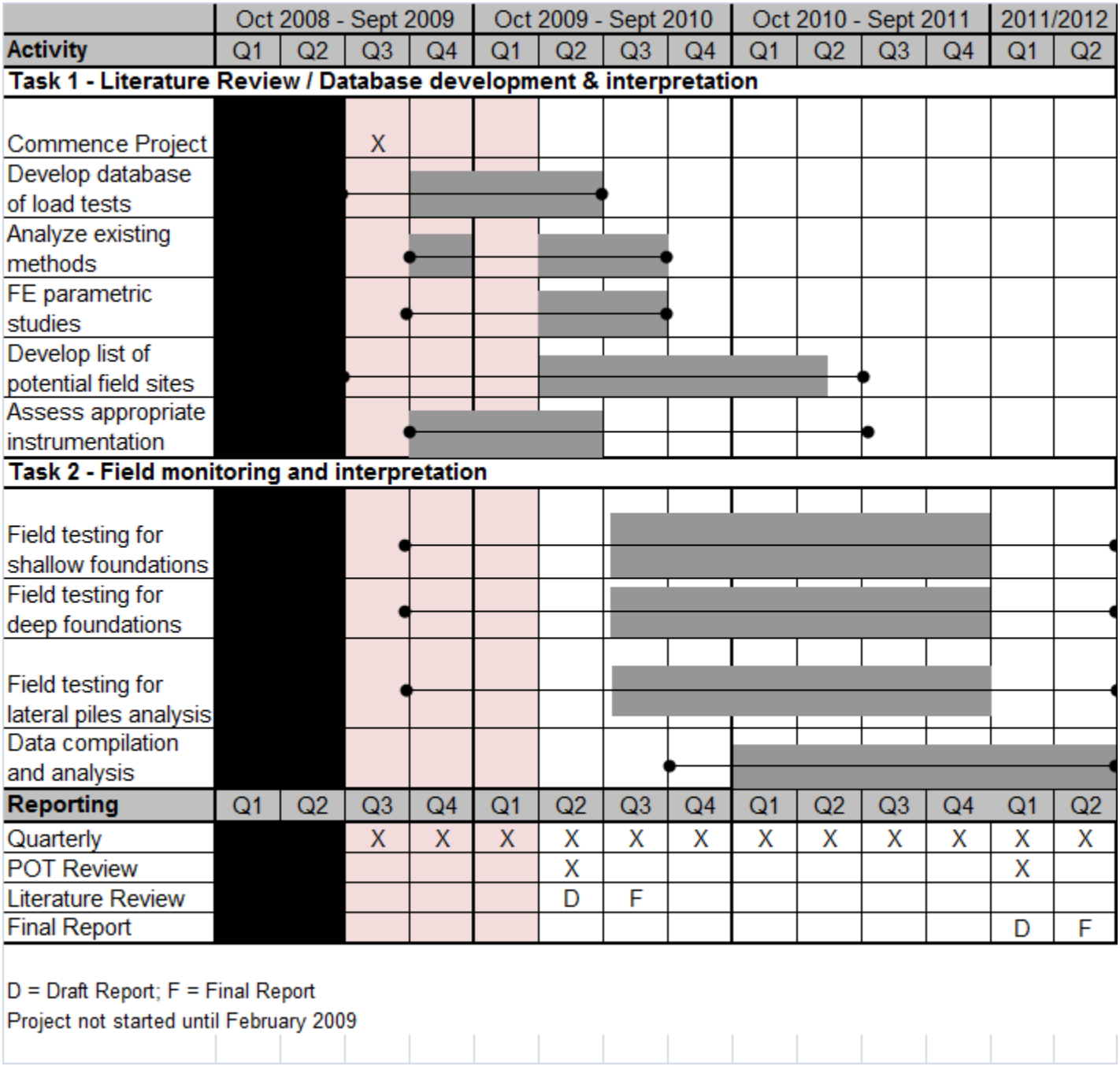
Hopefully we will install instrumentation at a field site.

Circumstances Affecting Progress and/or Budget:
There have been numerous problems with the wireless sensors remote data acquisition equipment. These problems have not been due to the use of the equipment, but problems with the units themselves. Various parts of the equipment have been returned to the manufacturer, and replaced. This does give us some concern with the reliability of these measurement devices.

At this time, no sites have been presented to us for instrumentation. This is slowing progress.

Additionally, the limited budget of this project has forced the research assistant to find additional funding as a teaching assistant. This has reduced the amount of funding that has been spent, but also the amount of work that has been accomplished this term.

Gantt Chart:


Oct 2008 - Sept 2009
Oct 2009 - Sept 2010
Oct 2010 - Sept 2011
2011/2012
Activity
Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2
Task 1 - Literature Review / Database development & interpretation
Commence Project
Develop database of load tests
Analyze existing methods
FE parametric studies
Develop list of potential field sites
Assess appropriate instrumentation
Task 2 - Field monitoring and interpretation
Field testing for shallow foundations
Field testing for deep foundations
Field testing for lateral piles analysis
Data compilation and analysis
Reporting
Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2
Quarterly X X X X X X X X X X X X
POT Review X X
Literature Review D F
Final Report D F
D = Draft Report; F = Final Report
Project not started until February 2009